Basics of Food Safety, Adulteration and Contaminants, Emerging Issues, Standardization and FSMS PART IV

Food Safety and Risk Analysis: Adulteration and detection

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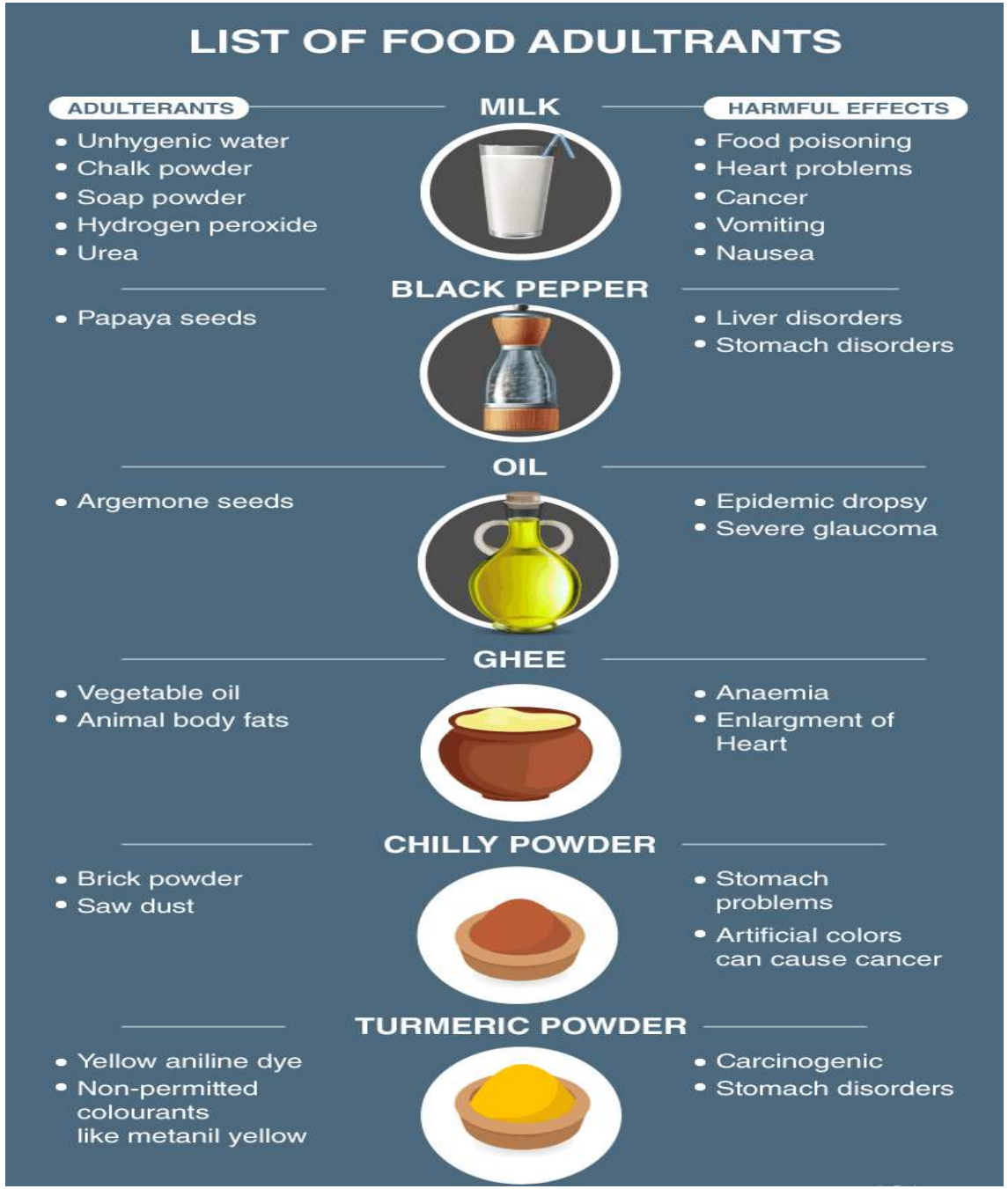
WHAT IS FOOD CONTAMINATION?

Food contamination is the **presence of harmful or unwanted substances in food** that make it **unsafe for consumption** and reduce its quality.

- Hidden chemicals in daily foods
- Major public health concern
- Affects all age groups
- Detectable by simple tests



Types of Food Contamination

Physical	Chemical	Biological	Allergenic	Cross
Hair or fur Dirt Metal Glass Plastic Bones Wood splinters Jewelry Fingernails Body parts Insects Small animals	Pesticides Insecticides Cleaning products Plastics Contaminated water Additives Preservatives Mercury / Lead Poisons Drugs	Bacteria Viruses Parasites Mold/fungi Yeast Algae Prions Microorganisms	Peanuts Dairy Soy Wheat Shellfish Egg Sesame seeds Mustard Sulfites	Equipment Touching Utensils Raw meat Cleaning Pests Illness

Emerging Issues in Food Safety

FOOD SAFETY TODAY

From Visible Adulteration to Invisible Hazards

- Earlier: stones, sand, colors
- Now: toxins, residues, resistant microbes

Cannot be seen, smelled, or tasted

WHY THESE ARE EMERGING ?

- Climate change
- Intensive agriculture
- Antibiotic misuse
- Poor storage & transport
- Global food chains

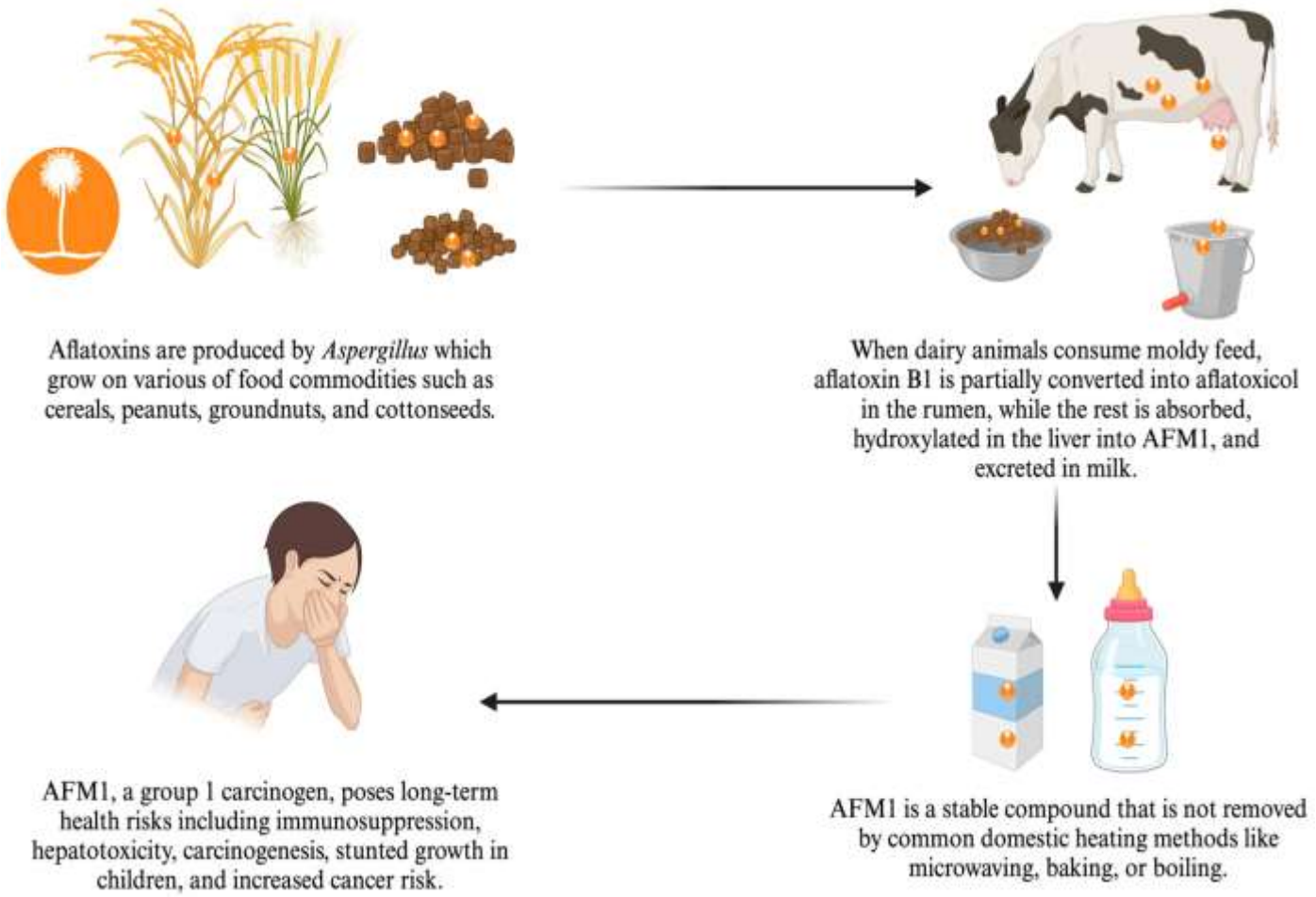
ROLE OF FOOD SAFETY OFFICERS

- Prevention, not only prosecution
- Risk-based inspection
- Sampling & surveillance
- Education of FBOs

STRATEGIES FOR IMPACTFUL FOOD SAFETY TRAINING
FOOD SAFETY TRAINING
Understand Food Safety Training Requirements
Develop Tailored Training Programs
Utilize Interactive and Engaging Learning Methods
Offer Continuous Training and Reinforcement
Empower Employees to Stay Involved
Recognize and Reward Compliance Efforts
Leverage Technology for Training Delivery

AFLATOXINS

•**Aflatoxins** are **toxic mycotoxins** produced by fungi
Aspergillus flavus and ***Aspergillus parasiticus***
•They contaminate food **before harvest**, **during storage**, and **during transport**
•**Heat-stable** → cooking, roasting, boiling **do NOT destroy** them


Aflatoxins are produced by *Aspergillus* which grow on various of food commodities such as cereals, peanuts, groundnuts, and cottonseeds.
When dairy animals consume moldy feed, aflatoxin B1 is partially converted into aflatoxicol in the rumen, while the rest is absorbed, hydroxylated in the liver into AFM1, and excreted in milk.
AFM1 is a stable compound that is not removed by common domestic heating methods like microwaving, baking, or boiling.
AFM1, a group 1 carcinogen, poses long-term health risks including immunosuppression, hepatotoxicity, carcinogenesis, stunted growth in children, and increased cancer risk.

FOODS AT HIGH RISK

- Maize
- Groundnut
- Spices
- Animal feed → milk (AFM1)

CONDITIONS FAVORING AFLATOXIN

- High moisture (>13%)
- Warm temperature
- Poor aeration
- Long storage

Warm weather and daily heating from the sun causes the grain to expand, heating and releasing moisture.

Cold weather and the nightly temperature drop results in grain shrinking (creating space along the walls) and condensation in the bin.

Moisture on the grain softens the haul creating an ideal sugar-rich environment for mold growth.

HEALTH IMPACT

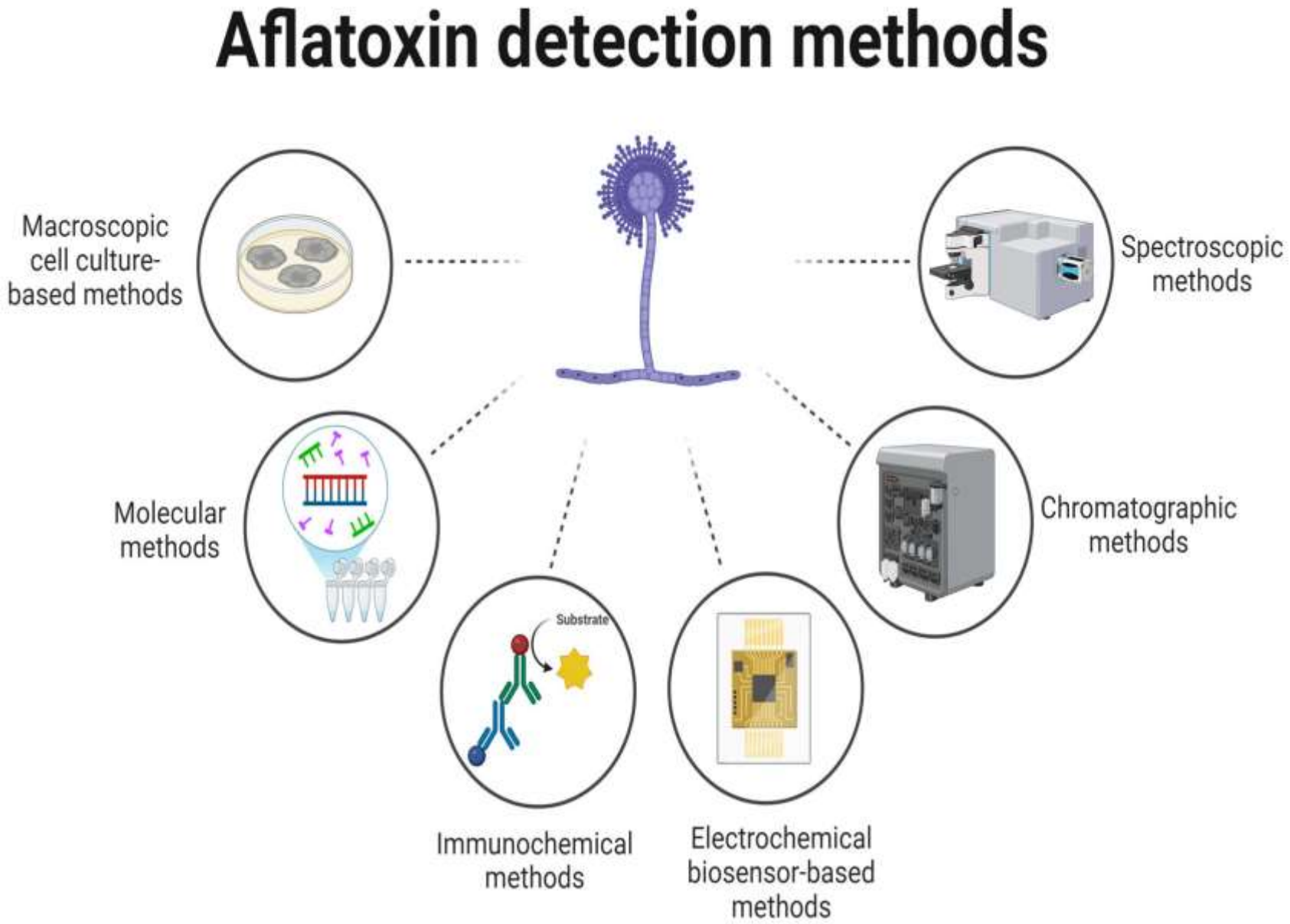
- Liver damage
- Hepatocellular carcinoma
- Child stunting
- Immunosuppression

REGULATORY LIMITS (INDIA)

- Aflatoxin B1 (food grains): ≤ **30 µg/kg**
- AFM1 (milk): ≤ **0.5 µg/kg**
- Zero tolerance for visibly moldy food

Intended Use	**Grain, Grain By-Product, Feed or other Products**	**Aflatoxin Level** [parts per billion (p.p.b.)]
Human consumption	Milk	0.5 p.p.b. (aflatoxin M1)
Human consumption	Foods, peanuts and peanut products, brazil and pistachio nuts	20 p.p.b.
Immature animals	Corn, peanut products, and other animal feeds and ingredients, excluding cottonseed meal	20 p.p.b.
Dairy animals, animals not listed above, or unknown use	Corn, peanut products, cottonseed, and other animal feeds and ingredients	20 p.p.b.
Breeding cattle, breeding swine and mature poultry	Corn and peanut products	100 p.p.b.
Finishing swine 100 pounds or greater in weight	Corn and peanut products	200 p.p.b.
Finishing (i.e., feedlot) beef cattle	Corn and peanut products	300 p.p.b.
Beef, cattle, swine or poultry, regardless of age or breeding status	Cottonseed meal	300 p.p.b.

- Rapid test kits (screening)
- HPLC / LC-MS (confirmation)
- Market & warehouse sampling



ANTIMICROBIAL RESISTANCE (AMR)

AMR (Antimicrobial Resistance) is the ability of microorganisms (bacteria, fungi, parasites, viruses) to survive and multiply despite the presence of antimicrobial drugs (antibiotics, antifungals, antivirals) that once killed them.
In food safety, AMR mainly concerns **antibiotic-resistant bacteria** transmitted through food.

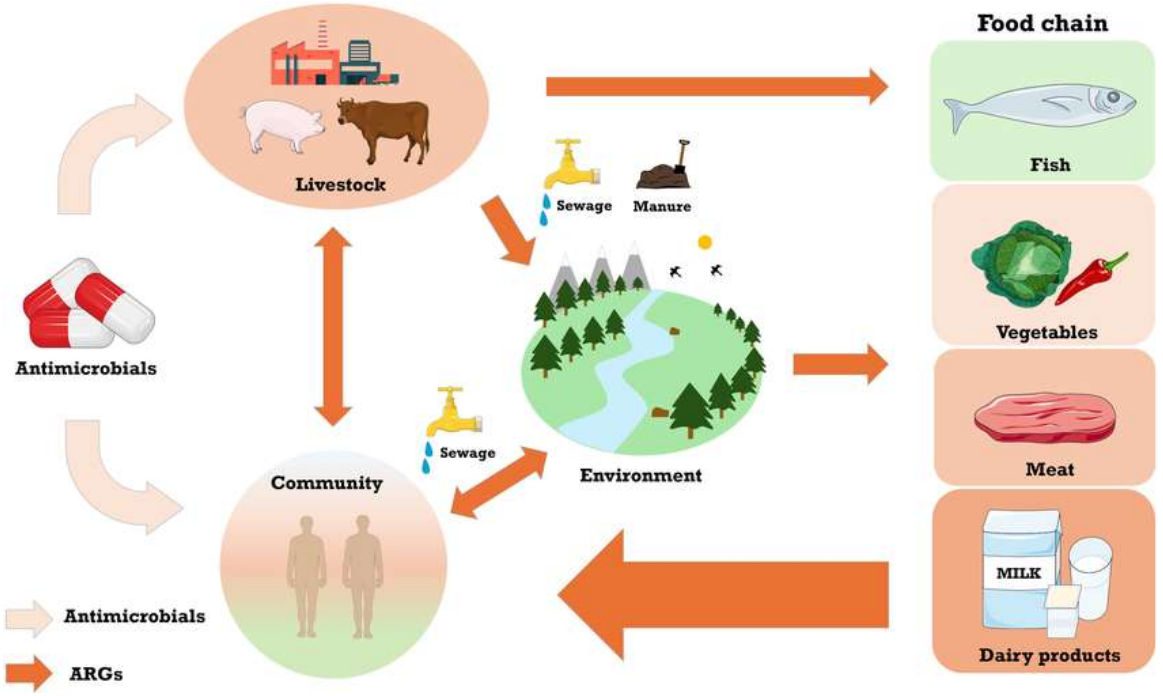
How AMR Develops

- Antibiotics are used excessively or incorrectly
- Sensitive bacteria die
- Resistant bacteria survive
- Resistant genes spread to other bacteria
- Infections become difficult or impossible to treat

AMR in the Food Chain (Why FSOs Should Care)

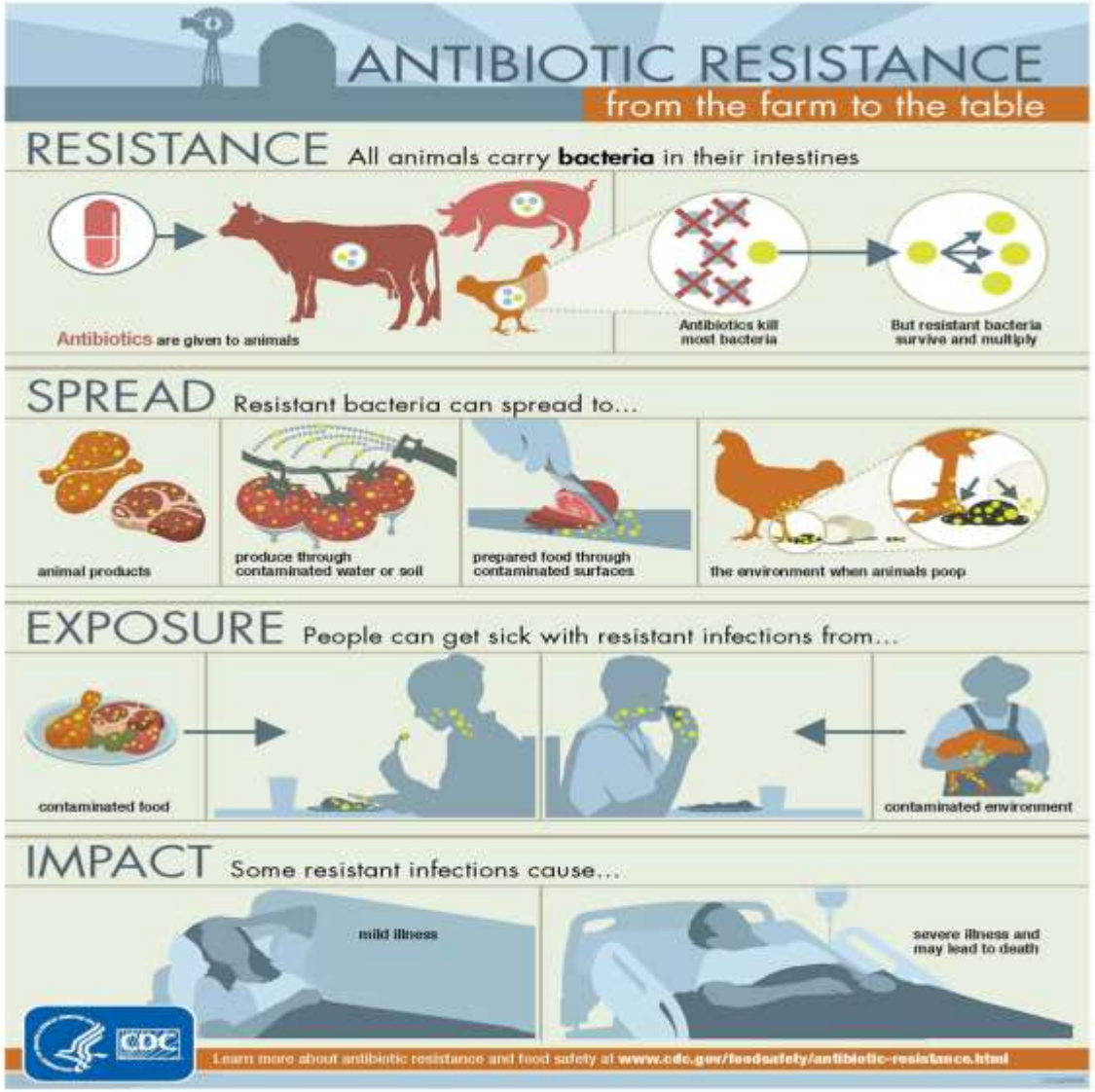
AMR does **not start in hospitals only** — it often begins in **farms and food systems**.

- **Major Entry Points:**
- Poultry farming
- Meat production
- Milk and dairy
- Fish and aquaculture



Main Causes of AMR Related to Food

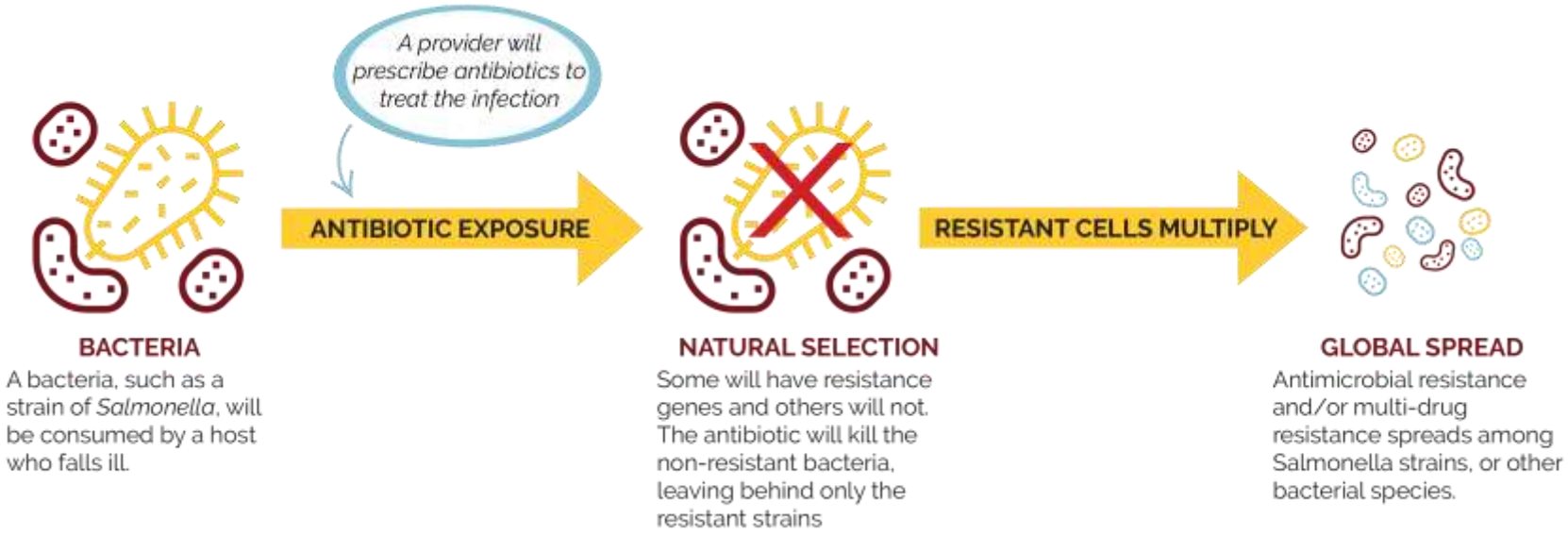
- Use of antibiotics as **growth promoters**
- Antibiotics given **without veterinary prescription**
- **Ignoring withdrawal period**
- Poor hygiene in farms and food handling
- Over-the-counter availability of antibiotics


ANTIBIOTIC RESISTANCE
from the farm to the table
RESISTANCE All animals carry bacteria in their intestines
Antibiotics are given to animals
Antibiotics kill most bacteria
But resistant bacteria survive and multiply
SPREAD Resistant bacteria can spread to...
animal products
produce through contaminated water or soil
prepared food through contaminated surfaces
the environment when animals poop
EXPOSURE People can get sick with resistant infections from...
contaminated food
contaminated environment
IMPACT Some resistant infections cause...
mild illness
severe illness and may lead to death
CDC
Learn more about antibiotic resistance and food safety at www.cdc.gov/foodsafety/antibiotic-resistance.html

Common AMR Bacteria Found in Food

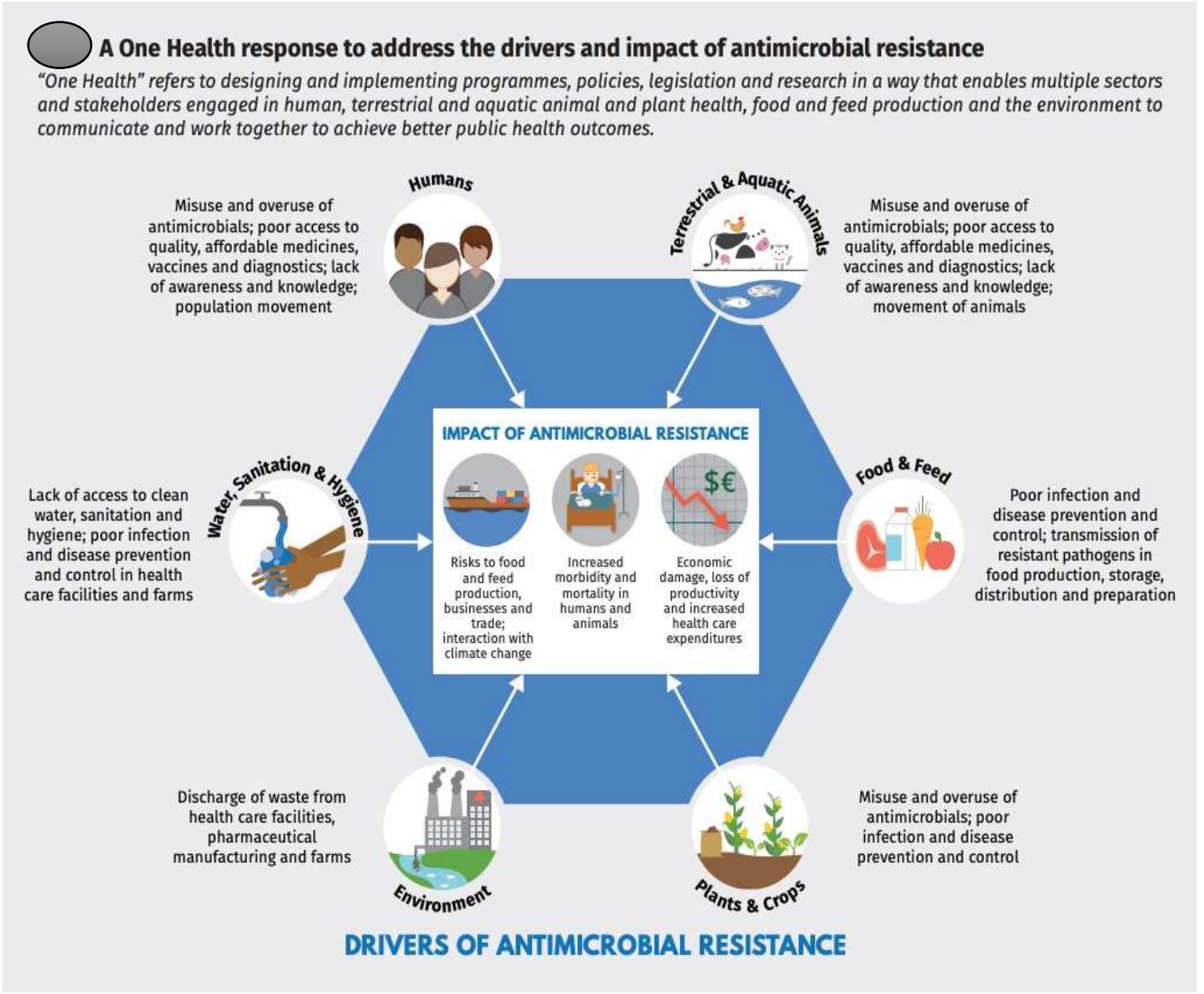
- *Salmonella* spp.
- *E. coli*
- *Campylobacter*
- *Staphylococcus aureus*

These can carry resistance genes to humans through food consumption.


A provider will prescribe antibiotics to treat the infection
ANTIBIOTIC EXPOSURE
RESISTANT CELLS MULTIPLY
BACTERIA
A bacteria, such as a strain of Salmonella, will be consumed by a host who falls ill.
NATURAL SELECTION
Some will have resistance genes and others will not. The antibiotic will kill the non-resistant bacteria, leaving behind only the resistant strains
GLOBAL SPREAD
Antimicrobial resistance and/or multi-drug resistance spreads among Salmonella strains, or other bacterial species.

Health Impact of AMR

- Antibiotics stop working
- Infections last longer
- Higher treatment cost
- Increased death rate
- Threat to modern medicine

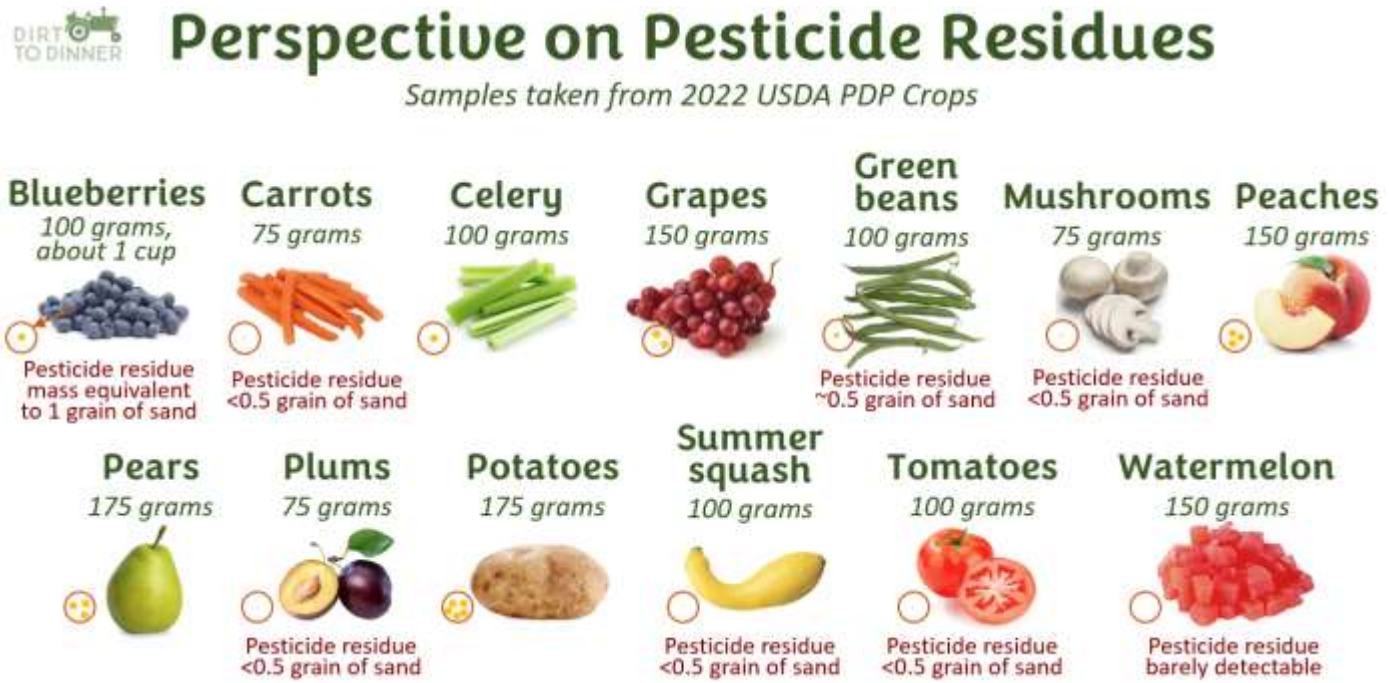

A One Health response to address the drivers and impact of antimicrobial resistance
"One Health" refers to designing and implementing programmes, policies, legislation and research in a way that enables multiple sectors and stakeholders engaged in human, terrestrial and aquatic animal and plant health, food and feed production and the environment to communicate and work together to achieve better public health outcomes.
Humans
Misuse and overuse of antimicrobials; poor access to quality, affordable medicines, vaccines and diagnostics; lack of awareness and knowledge; population movement
Terrestrial & Aquatic Animals
Misuse and overuse of antimicrobials; poor access to quality, affordable medicines, vaccines and diagnostics; lack of awareness and knowledge; movement of animals
IMPACT OF ANTIMICROBIAL RESISTANCE
Risks to food and feed production, businesses and trade; interaction with climate change
Increased morbidity and mortality in humans and animals
Economic damage, loss of productivity and increased health care expenditures
Water, Sanitation & Hygiene
Lack of access to clean water, sanitation and hygiene; poor infection and disease prevention and control in health care facilities and farms
Food & Feed
Poor infection and disease prevention and control; transmission of resistant pathogens in food production, storage, distribution and preparation
Environment
Discharge of waste from health care facilities, pharmaceutical manufacturing and farms
Plants & Crops
Misuse and overuse of antimicrobials; poor infection and disease prevention and control
DRIVERS OF ANTIMICROBIAL RESISTANCE

Role of Food Safety Officers (FSOs) in Controlling AMR

- FSOs **cannot treat AMR**, but they **can prevent its spread**.
- **Key Responsibilities:**
- Enforce **withdrawal periods**
- Check veterinary drug records
- Sample meat, milk, fish for residues
- Ensure hygiene (Schedule IV)
- Educate Food Business Operators (FBOs)

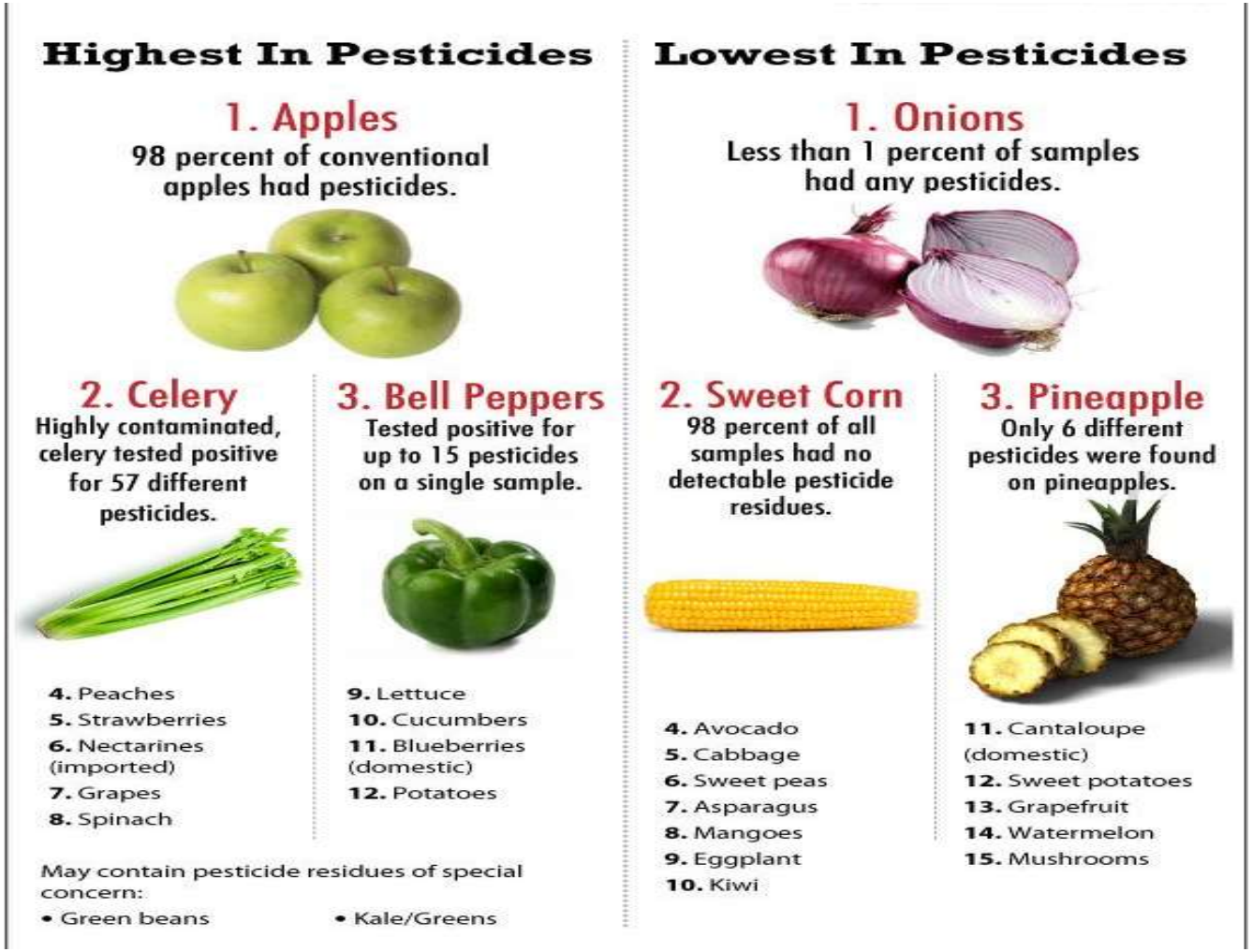
PESTICIDE RESIDUES

- Chemicals remaining after spraying
- Chronic low-dose exposure
- Often within food appearing fresh



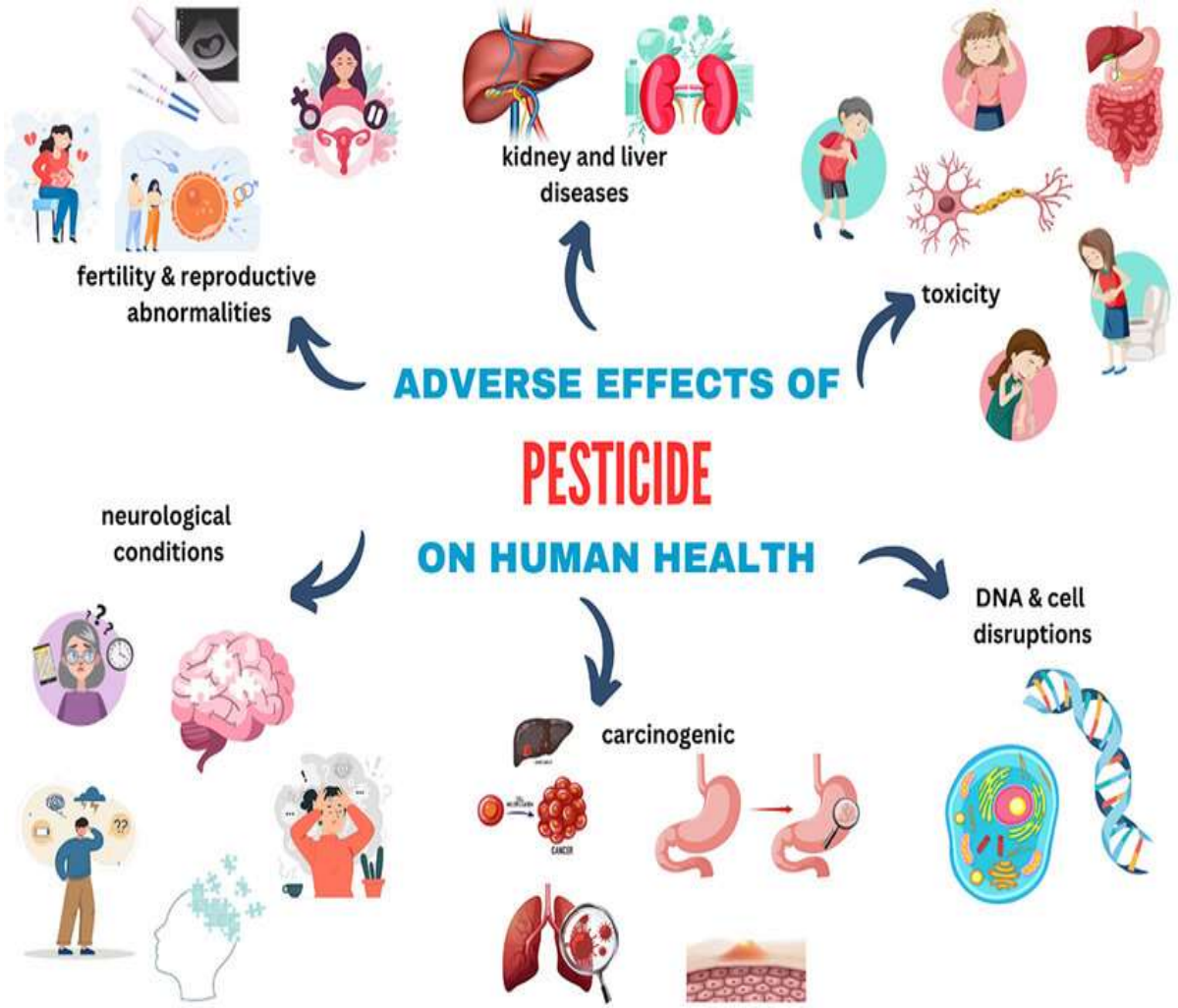
HIGH-RISK FOODS

- Leafy vegetables
- Fruits
- Cereals
- Spices



WHY THEY ARE DANGEROUS

- Endocrine disruption
- Neurotoxicity
- Carcinogenicity
- Bioaccumulation

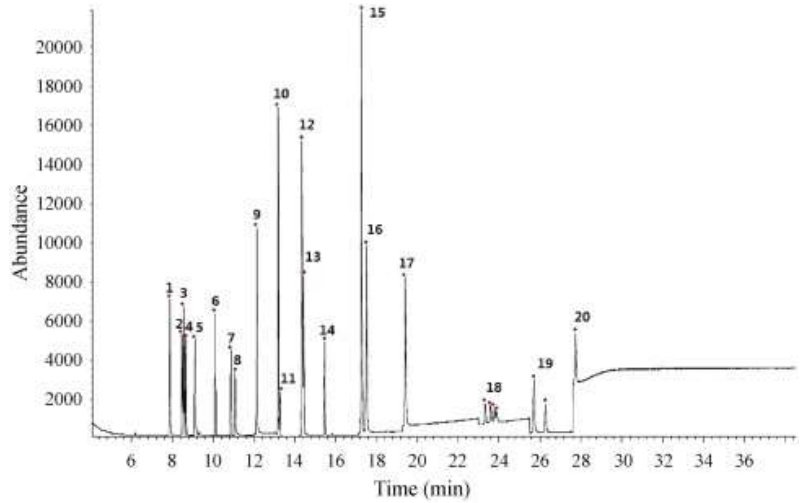


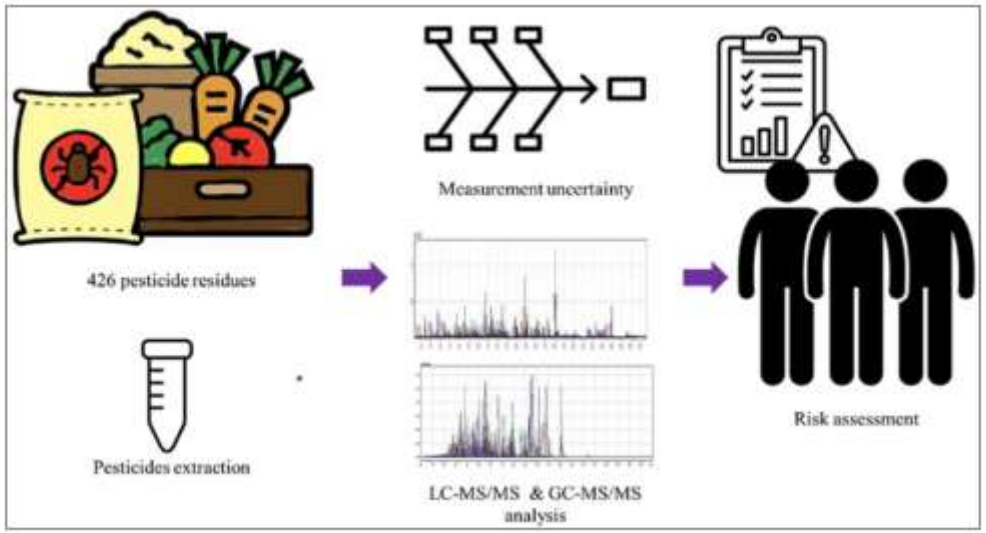
CAUSES OF VIOLATION

- Over-dosage
- Wrong pesticide
- Early harvesting
- No farmer training

DETECTION METHODS

- GC-MS
- LC-MS/MS
- Multi-residue screening

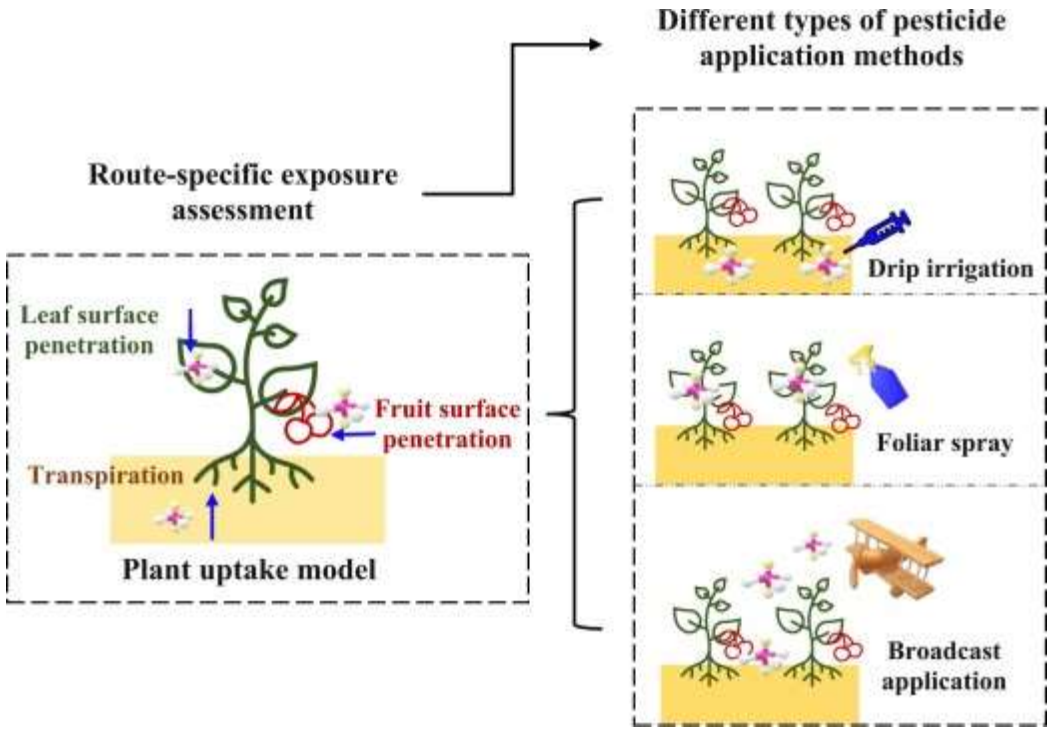




BEHAVIOR OF PESTICIDE RESIDUES IN FOOD

What Happens After Spraying?

- Some residues remain on **surface**
- Some **penetrate plant tissues**
- Some **accumulate in fat** (animal foods)
- Many degrade slowly → chronic exposure
- **Key Teaching Point for FSOs**



Washing reduces residues partially does NOT ensure safety

ENFORCEMENT & PREVENTION STRATEGY

Where FSOs Can Intervene

- Market-level sampling
- Source tracing
- Farmer awareness programs
- Coordination with agriculture dept.

Common Enforcement Mistake

❌ Focusing only on visible dirt

☑ Focusing on **MRL exceedance**

Conclusion: Emerging Food Safety Challenges

- **Modern food safety threats are invisible, chronic, and science-driven**
- **Aflatoxins, Antimicrobial Resistance (AMR), and Pesticide Residues pose serious long-term public health risks**
- **<u>Effective control depends on:</u>**
  - **Preventive inspection**
  - **Risk-based sampling**
  - **Strict enforcement of Schedule IV (FSS Regulations, 2011)**
- **Food Safety Officers play a critical frontline role in protecting public health**
- **Prevention is always more effective than punishment**
- **Safe food today requires vigilance, science, and compliance, not assumptions**

TURMERIC ADULTERATION

Adulterant : Lead chromate

- Added for bright yellow color
- Rub on wet paper → yellow streak
- Settles fast in water
- Causes lead toxicity
- Damages liver & kidneys

1. WATER SETTLING TEST (Primary Test)

Procedure

1.Take 1 teaspoon turmeric powder

2.Add to a glass of water

3.Do **not stir**

Observation

• ✗ **Adulterated**: Bright yellow color spreads quickly

• ☑ **Pure**: Turmeric settles at bottom, water stays clear

Reason

Lead chromate and dyes dissolve faster than natural curcumin.

2. PAPER / TISSUE TEST

Procedure

Place turmeric on wet tissue or blotting paper

Observation

✗ **Adulterated:** Strong yellow stain spreads

☑ **Pure:** Mild, uneven stain

Use

Good for street-level screening, not confirmatory.

3. ACID TEST (FOR LEAD CHROMATE)

Procedure

Take turmeric in a test tube

Add a few drops of dilute nitric acid (HNO_3)

Observation

✗ Pink / magenta color → lead chromate present

☑ No color change → likely pure

⚠ **Lab or trained handling recommended**

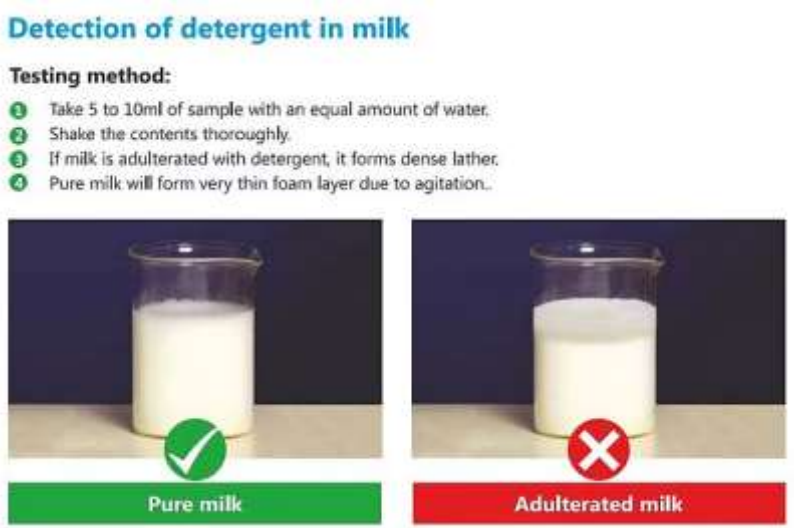
MILK ADULTERATION

Adulterant : Detergent / urea
Water dilution common
•Shaking → excess foam
•Slippery feel (urea)
•Kidney stress
•Unsafe for children

HOW TO IDENTIFY ?

1. WATER ADULTERATION TEST
Procedure
•Put a drop of milk on a **clean slanting surface**
Observation
• ❌ **Adulterated: flows quickly, leaves no trail**
• ☑ **Pure: flows slowly, leaves a white trail**
Reason
Added water reduces milk's natural viscosity.

2. DETERGENT TEST (FOAM TEST)

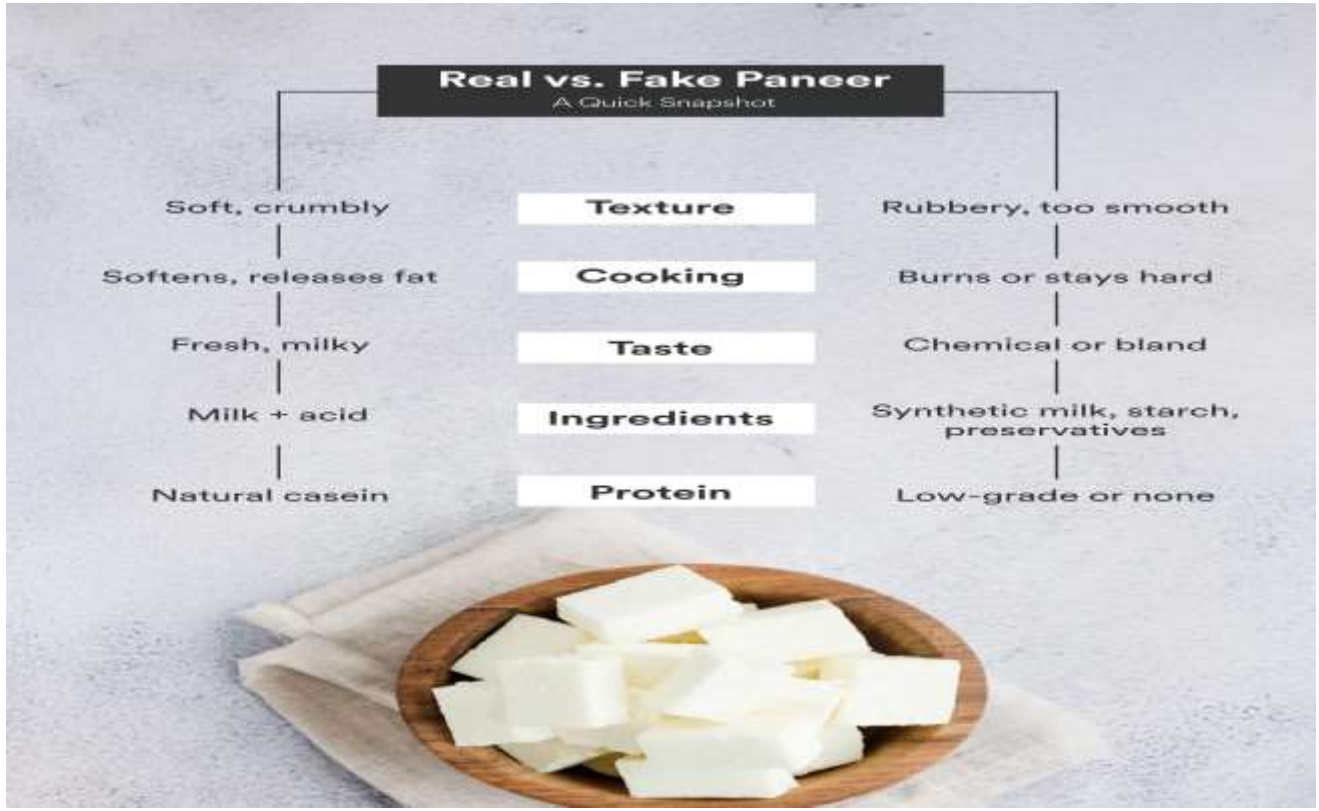

Detection of detergent in milk
Testing method:
1 Take 5 to 10ml of sample with an equal amount of water.
2 Shake the contents thoroughly.
3 If milk is adulterated with detergent, it forms dense lather.
4 Pure milk will form very thin foam layer due to agitation.
Pure milk
Adulterated milk

3.UREA TEST (SLIPPERY FEEL TEST)
Procedure
•Rub a drop of milk between fingers
Observation
• ❌ **Soapy / slippery feel → urea added**
• ☑ **Normal milky feel → pure**
Why urea is added
To falsely increase SNF (solids-not-fat).

FAKE PANEER

Adulterant : Starch / synthetic solids
Made from starch or detergent
•Iodine → blue color
•Melts in hot water
•Poor protein quality
•Causes digestion problems

HOW TO IDENTIFY ?



1. IODINE TEST (MOST IMPORTANT & CONFIRMATORY)
Adulterant detected: *Starch / synthetic solids*
Procedure
1.Take a small piece of paneer
2.Add 2–3 drops of iodine solution
Observation
• ❌ **Blue / bluish-black color → starch present (fake paneer)**
• ☑ **No color change → pure paneer**
Reason
Natural paneer contains **protein (casein)**, **not starch**. Iodine reacts only with starch.

2. HOT WATER TEST
Adulterant detected: Synthetic solids / detergent
Procedure
Put paneer piece in **hot (not boiling) water**
Observation
• ❌ **Melts, becomes rubbery or slimy → adulterated**
• ☑ **Remains firm, soft texture → pure paneer**

3. SMELL & TEXTURE TEST (SUPPORTING)
Adulterant detected: Detergent / low-quality solids
Observation
• ❌ **Chemical / soapy smell, rubbery texture**
• ☑ **Mild milky smell, crumbly-soft texture**

PLASTIC RICE

Adulterant : Plastic polymer
Synthetic resin grains
•Floats in water
•Burns with plastic smell
•Not digestible
•Long-term cancer risk

1. WATER FLOAT TEST (PRIMARY SCREENING)
Procedure
•Put a handful of rice grains in a bowl of water
Observation
• ❌ **Adulterated: grains float**
• ☑ **Pure: grains sink**
Reason
Plastic has lower density than water.

2. BURNING TEST (CONFIRMATORY)
Procedure
•Take 1–2 grains, hold with forceps, burn carefully
Observation
• ❌ **Adulterated: melts/burns with plastic smell**
• ☑ **Pure: chars like organic matter, no plastic odor**
⚠ ***Do this in a ventilated area***

3. COOKING TEST (SUPPORTING)
Observation
• ❌ Grains remain hard, stick unnaturally, don't soften well
• ☑ Normal swelling and soft texture

HONEY ADULTERATION

- Mixed with glucose syrup
- Spreads rapidly in water
- No thread formation
- High glycemic load
- Misleads diabetic patients

HOW TO IDENTIFY ?

1. WATER DISPERSION TEST (PRIMARY)
Procedure
- Add 1 tsp honey to a glass of water (do not stir)

Observation
- ❌ **Adulterated:** spreads/dissolves quickly
- ☑ **Pure:** settles as a lump before slowly dispersing

Why
Syrups dissolve faster than natural honey.

2. FLAME / MATCHSTICK TEST (SUPPORTING)
Procedure
- Dip a dry matchstick in honey and try to light it

Observation
- ❌ **Adulterated:** won't light / crackles (moisture from syrup)
- ☑ **Pure:** lights easily

⚠ Use caution; not definitive alone.

3. PAPER / BLOTTING TEST
Procedure
- Put a drop on blotting paper or tissue

Observation
- ❌ **Adulterated:** spreads/soaks through (watery)
- ☑ **Pure:** stays thick, minimal spread

4. VISUAL & FLOW CHECK
Observation
- ❌ Very runny, uniform flow (syrupy)
- ☑ Thick, viscous flow; may crystallize over time

CHILLI POWDER ADULTERATION

Adulterant : Brick powder / dye Artificial red color

- Settles quickly in water
- Red streaks appear
- Toxic dyes present
- Liver damage risk

HOW TO IDENTIFY ?

1. WATER SETTLING TEST (PRIMARY)

Procedure

- Add 1 teaspoon chilli powder to a glass of water
- Do not stir

Observation

❌ **Adulterated:** heavy particles settle quickly at the bottom

❌ Red color streaks spread in water

☑ **Pure:** floats initially; water stays mostly clear

Reason

Brick powder is dense; dyes dissolve rapidly.

2. PAPER / COTTON TEST (FOR DYES)

Procedure

- Sprinkle chilli powder on **wet cotton or tissue**

Observation

- ❌ **Bright red streaks / stains** → synthetic dye present
- ☑ **Mild, dull stain** → natural chilli pigment

3. RUB TEST

Procedure

- Rub chilli powder between fingers

Observation

- ❌ **Greasy feel + intense red stain** → dye adulteration
- ☑ **Dry feel, mild stain** → pure

SWEETS ADULTERATION

Adulterant : Aluminum foil
Fake silver foil (vark) used
•Rub on paper → black residue
•Real silver dissolves, fake doesn't
•Heavy metal exposure
•Long-term toxicity risk

1. SILVER FOIL (VARK) TEST
Procedure
•Gently rub silver foil (vark) from sweet onto white paper or cotton
Observation
• ❌ **Black/grey mark** → fake (aluminum foil)
• ☑ **No mark** → real edible silver
Reason
Real silver is inert; aluminum reacts and leaves residue.

2. ARTIFICIAL COLOR TEST
Adulterant: Synthetic food dyes
Procedure
•Wash a small piece of sweet in warm water
Observation
• ❌ **Colored water / streaks** → artificial dye
• ☑ **No color release** → natural ingredients

3. STARCH TEST (IODINE TEST)
Adulterant: Starch / flour fillers
Procedure
•Add a drop of **iodine solution** on sweet sample
Observation
• ❌ **Blue/black color** → starch present
• ☑ **No color change** → starch absent

TEA & COFFEE ADULTERATION

Adulterant: Iron filings / chicory

Used leaves reused

•Magnet attracts iron

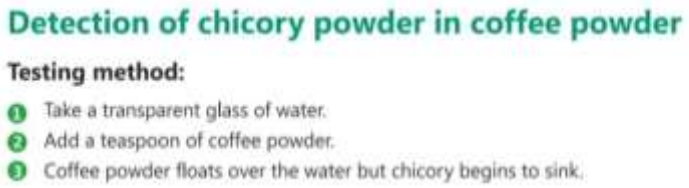
•Color releases fast

•Stomach irritation

•Poor mineral safety

COFFEE ADULTERATION TESTS

1) Water Sinking Test (chicory)


Detection of chicory powder in coffee powder
Testing method:
1 Take a transparent glass of water.
2 Add a teaspoon of coffee powder.
3 Coffee powder floats over the water but chicory begins to sink.

TEA ADULTERATION TESTS

Adulterants: Iron filings, reused leaves, artificial color

1) Magnet Test (iron filings)

•**Procedure:** Pass a magnet near dry tea leaves

•**Result:** ✗ Leaves stick → iron present

•☑ No attraction → pure

2) Water Color Test (added dye / reused leaves)

•**Procedure:** Sprinkle tea on cold water (don't stir)

Result: ✗ Instant dark color → dye/used leaves

• ☑ Slow infusion → pure

3) Rub Test (used leaves)

•**Procedure:** Rub between fingers

•**Result:** ✗ Coarse/unnatural color transfer

• ☑ Natural texture

Health risk: Metal toxicity, gastric irritation

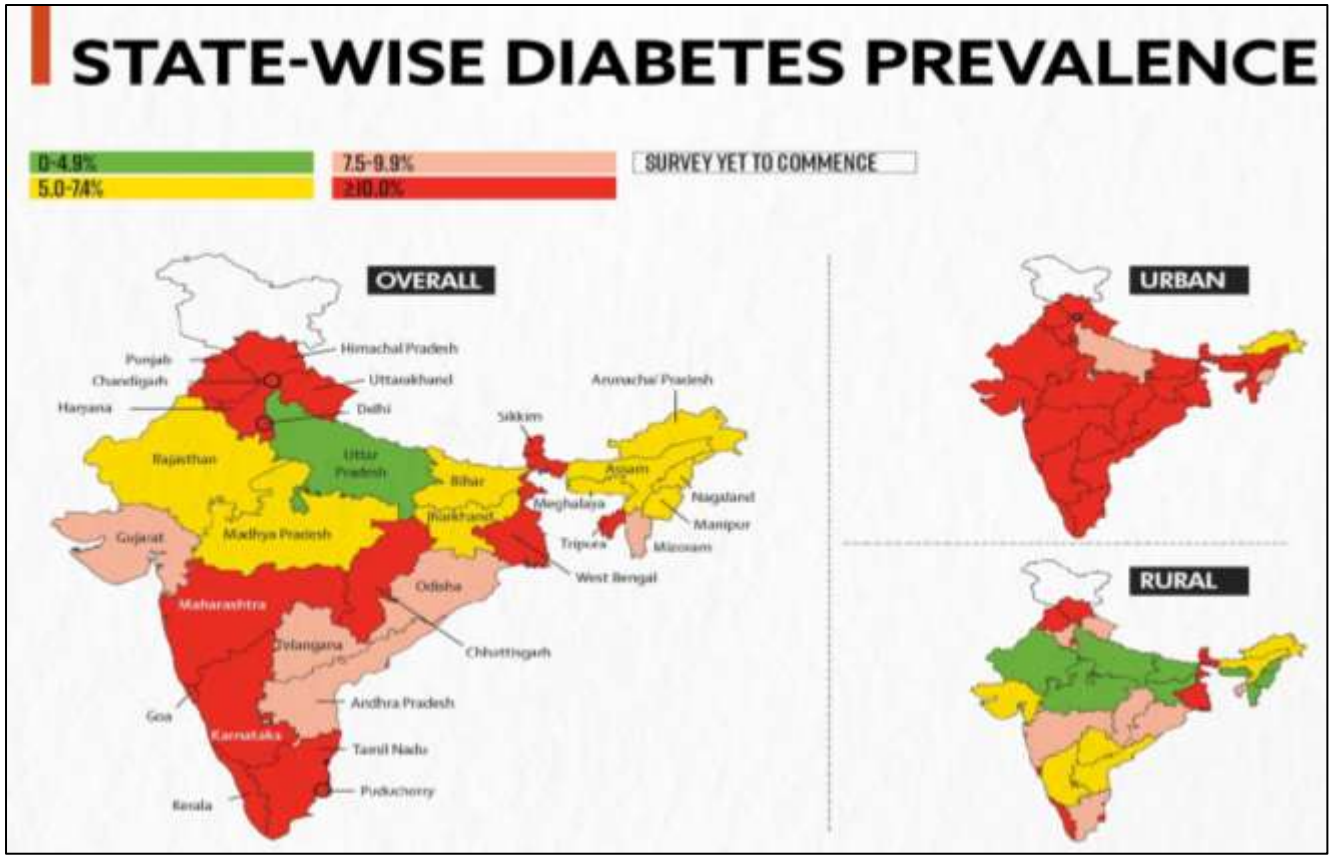
The Sweet India : Unraveling the Genetics and Lifestyle Factors of Diabetes

The higher prevalence of diabetes in peninsular India's population compared to population in Gangetic plain can be attributed to several interconnected factors, including genetics, lifestyle, dietary habits, and socio-economic conditions. Here are some key reasons:

1. Dietary Differences

Traditionally, the Indian peninsula diet is rich in carbohydrates, rice being the staple food, which has a high glycemic index and can lead to spikes in blood sugar levels. The frequent consumption of rice, combined with sugary foods and a higher intake of processed foods in urban areas, may contribute to the increased risk of diabetes.

While in Indo-Gangetic Plain diets also contain carbohydrates (like wheat-based chapati or roti), they often include a more balanced intake of proteins, dairy, and vegetables. This diet, with lower reliance on high glycemic foods, may contribute to better blood sugar management compared to a predominantly rice-based diet.

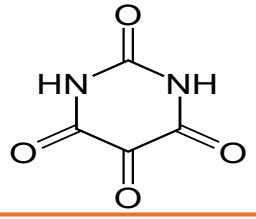


2. Genetic Factors: South Asians, in general, have a higher genetic predisposition to insulin resistance and diabetes. Studies suggest that South Indians, in particular, may have a greater genetic susceptibility to type 2 diabetes due to factors such as higher insulin resistance and impaired beta-cell function.

3. Physical Activity and Urbanization:
South India has experienced rapid urbanization, leading to a more sedentary lifestyle in urban populations. This reduction in physical activity, combined with dietary factors, significantly increases the risk of obesity and type 2 diabetes.
In comparison, some rural areas of North India still retain more physically demanding agricultural lifestyles, which might contribute to lower diabetes rates in these populations.

4. Socio-Economic and Cultural Factors: South Indian populations may also experience unique socio-economic factors, such as increased work stress in highly urbanized regions, and a cultural inclination toward consuming high-calorie foods during festivals and social gatherings, leading to weight gain and diabetes risk.

Low Glycemic Foods



Alloxans

- Alloxan is a toxic known carcinogen. It is used in science research to destroy the beta cells on the pancreas of test animals to create diabetes, so that we have a better understanding of the disease.. So why would it be in bleached flour? Surely they would not be adding it as the consequences would not be good for human health?

- **Alloxan, pyrimidine-2,4,5,6(1H,3H)-tetraone,** is a tetracarbonyl compound that is biologically formed by the enzymatic oxidation of uric acid in the human intestine (Murthy et al. 2019). The amount of alloxan in human plasma is ranged from 0.02 to 0.2 mg %, w/v (Sobotka and Luisada- Opper 1954). Alloxan was reported to induce kidney damage at high blood levels (Federiuk et al. 2004).

- In addition, alloxan is used to cause a cytotoxic effect on experimental animal cells and it has been used to induce diabetes in the Chinese hamster (Suckow et al. 2012). Alloxan was found to induce type I and type II diabetes mellitus in experimental animals in a dosing regimen dependent manner (Federiuk et al. 2004).

- Furthermore, Mrozikiewicz et al. (1994)) confirmed that alloxan blood levels in children with insulin-dependent diabetesmellitus have a significant difference compared to the controlled children.

- While in the liver, glutathione peroxidase activity and the exogenous peroxide resistanceare about 20 times higher than in pancreatic islets. Thus, it could be concluded that the selective cytotoxic effect of alloxan to beta cell is not only due to the its rapid cellular uptake to beta cells through GLUT2, but also due to the high sensitivity of the beta cell itself to peroxides (Malaisse et al. 1982).

- **It was reported that alloxan was speculated to be generated during the bleaching process in considerable amounts (Shakila and Sasikala 2012) and that was confirmed by an LC/MS method (Giaccone et al. 2017). Usually, many bleaching agents were utilized, such as chlorine dioxide, benzoyl peroxide, nitrosyl chloride chlorine gas, and/or nitrogen oxides (Chittrakorn et al. 2014). These series of oxidizing agents modify many flour components and lead to the formation of the toxic side product alloxan (Fukayama et al. 1986; Thomasson et al. 1995).**

- **In the same context, several food products are made by bleached wheat flour, which is called all-purpose flour, which is finely milled, fiberless, refined, and naturally or chemically bleached flour from wheat. The presence of alloxan in all-purpose flour as well as in baked food products from the flour is unexplored yet in detail and is the need of the hour.**

- **Until now, few methods for estimation of alloxan were reported which included post-derivatization spectrophotometric (Archibald 1945) and chromatographic (HPLC) (Raghavamenon et al. 2009) methods, and label-free flow injection analysis (FIA) method coupled either with colorimetric or amperometric detection (Shpigun et al. 2008) based on alloxan redox properties.**

- **Regarding the LC-MS/MS method, despite its exclusive specificity owing to tandem mass properties, it had some limitations such as high cost of instrumentation, need of experienced analyst, and this comes with achieving only moderate sensitivity (limit of detection; 730 ng/g).**

- **On the other hand, the fluorometric method needs only low-cost analytical instrumentations and at the same time offers the purpose of high sensitivity without the loss of precision or specificity (Walash et al. 2011, 2012; El-Maghrabey et al. 2018; Abdel-Lateef et al. 2019). Hence, in this study, we aim to introduce a time-saving and cost-effective spectrofluorometric method for estimating of alloxan in flour as well as in flour-based food samples.**

RISK ASSESSMENT OF WHITE/POLISHED RICE AFTER PACKAGING

"White or polished rice" is a staple food consumed widely due to its ease of cooking and appealing texture. However, the polishing process strips away vital nutrients, leading to potential health and environmental concerns when combined with improper packaging practices.

Packaging Risks

Contamination:

- Polished rice is prone to contamination during storage and packaging.
- Pests, fungi, and microorganisms may infiltrate if the packaging is not airtight or damaged.
- Poor storage conditions can exacerbate these risks, leading to spoilage and foodborne illnesses.

Nutrient Loss:

- The milling and polishing processes already remove most of the B vitamins and minerals like iron and magnesium.
- Extended storage in suboptimal conditions accelerates nutrient degradation, reducing the nutritional value of the rice.

Plastic Packaging Concerns:

- Plastic packaging materials can leach harmful chemicals, such as phthalates and bisphenol A (BPA), into the rice.
- These chemicals pose potential health risks, including hormonal disruption and carcinogenic effects.

Health Implications

Increased Glycemic Index:

- Polished rice has a high glycemic index (GI), which can lead to rapid spikes in blood sugar levels.
- Prolonged consumption increases the risk of type 2 diabetes and associated metabolic disorders.

Nutritional Deficiencies:

- Reliance on polished rice as a dietary staple without supplementation can lead to deficiencies in essential nutrients like thiamine (B1), leading to conditions such as beriberi.

Risk Assessment of Plastic Rice

"Plastic rice" refers to counterfeit rice made from synthetic materials like plastic resins or other non-edible substances that mimic the appearance of real rice. This dangerous adulteration is often a fraudulent attempt to reduce production costs, posing significant risks to consumer health.

Packaging Risks

Toxins Release

•Plastic rice, being synthetic, contains chemicals that may leach into surrounding food or packaging.
•These chemicals, such as phthalates or heavy metals, can contaminate other food items during transport or storage.

Microbial Contamination

•Improper storage or packaging of plastic rice can create a humid environment, allowing **pathogens** like bacteria and fungi to grow.
•These pathogens can produce toxins that exacerbate health risks.

Health Implications

Indigestible Plastic Compounds

•Synthetic rice is non-biodegradable and cannot be digested by the human gastrointestinal system.
•Consumption can lead to **intestinal blockages**, discomfort, and long-term digestive issues.

Carcinogenic Potential

•Long-term exposure to synthetic chemicals in plastic rice increases the risk of cancer.
•Many of these compounds, like BPA and styrene, are known carcinogens and disruptors of the endocrine system.

The production and distribution of plastic rice pose severe risks to food safety and public health. Proper monitoring and strict regulations are essential to prevent the manufacture and sale of this harmful counterfeit product.

Risk Assessment of Fortified Rice After Packaging

"Fortified rice" is rice enriched with essential vitamins and minerals such as folic acid, iron, and zinc to combat malnutrition, particularly in populations with limited access to diverse diets. This innovative solution has been widely adopted in food programs aimed at reducing nutrient deficiencies.

Packaging Risks

Nutrient Stability

•Added nutrients in fortified rice, like **folic acid, vitamin B12, and iron**, are sensitive to external conditions such as **light, heat, and moisture**.

•Prolonged storage or poor packaging can result in the **degradation of these nutrients**, reducing the intended health benefits.

Contamination

•Improperly sealed or damaged packaging increases the risk of **contamination** by pests, microorganisms, and environmental pollutants.

•Packaging materials must be designed to maintain the integrity of both the rice grains and the fortified nutrients.

Health Benefits and Risks

Positive Impacts

•**Combatting Malnutrition**: Fortified rice effectively addresses **anemia** and micronutrient deficiencies, particularly in children and pregnant women.

•**Health Outcomes**: Regular consumption improves immune function, cognitive development, and overall well-being.

Negative Impacts

•**Over-Fortification Risks**: Excessive consumption of fortified rice may lead to conditions like **hypervitaminosis** (e.g., excess iron causing oxidative stress) in individuals not requiring supplementation.

•Vulnerable groups, such as young children and the elderly, may face unintended health risks due to inappropriate dosing.

Comparative Analysis of Rice Types After Packaging

Feature	White Rice	Plastic Rice	Fortified Rice
Nutritional Value	Low (stripped nutrients)	None (adulteration)	High (added nutrients)
Health Risks	High GI, diabetes	Gastrointestinal issues	Risk of over-fortification
Packaging Risks	Chemical migration, pests	Chemical toxicity	Nutrient degradation
Long-Term Impact	Poor health outcomes	Severe health hazards	Positive, if properly managed

Oils in Packaging Bakery Goods: Uses and Risks

Role of Oils in Packaging:

- Enhances texture and flavor retention.
- Acts as a moisture barrier in biscuits and bakery goods.

Harmful Effects:

- **Trans Fats**: Use of hydrogenated oils linked to cardiovascular diseases.
- **Chemical Migration**: Oils can interact with packaging, releasing harmful chemicals.
- **Oxidative Rancidity**: Leads to off-flavors and potential toxin formation.

Alternatives: Promote plant-based, non-hydrogenated oils for health safety.

Schedule IV of the *Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011*

It describes the **General Hygienic and Sanitary Practices** that all Food Business Operators (FBOs) must follow. It forms the backbone of the **Food Safety Management System (FSMS)** in India, emphasizing **Good Manufacturing Practices (GMP)** and **Good Hygiene Practices (GHP)** across different categories of food businesses.

Purpose of FSMS Schedule IV

To ensure food safety by mandating hygienic and sanitary conditions in food handling, processing, storage, distribution, and service.

Applicability: All food business operators (FBOs), whether registered or licensed, must comply.Foundation: Based on Hazard Analysis and Critical Control Point (HACCP) principles, supported by GMP and GHP

Schedule IV is divided into five parts, each tailored to specific types of food businesses

Part	Focus Area	Examples of Requirements
Part I	General hygienic and sanitary practices for all FBOs	Clean premises, pest control, safe water supply
Part II	Manufacturing/processing units	Equipment hygiene, raw material handling, waste disposal
Part III	Milk and milk products	Hygienic milking, storage at proper temperatures, pasteurization
Part IV	Meat and meat products	Slaughterhouse hygiene, cold storage, prevention of contamination
Part V	Catering/foodservice establishments	Kitchen cleanliness, personal hygiene of staff, safe food storage and transport

Part I – Petty Food Business Operators

(hawkers, street vendors, small retailers, temporary stall holders)

- ✓ Premises kept clean and free from pests
- ✓ Potable water used for food preparation
- ✓ Food stored in clean, covered containers
- ✓ Personal hygiene: clean clothing, trimmed nails, no open wounds
- ✓ Waste disposed safely, away from food areas
- ✓ Food protected from dust, flies, and direct sunlight
- ✓ Utensils cleaned daily with safe water
- ✓ No smoking, spitting, or chewing tobacco near food

Part II – Food Manufacturing/Processing Units

(factories, processing plants, packaging units)

- ✓ Layout designed to prevent cross-contamination
- ✓ Walls, floors, ceilings smooth, washable, and pest-proof
- ✓ Adequate ventilation and lighting
- ✓ Equipment made of food-grade material, cleaned regularly
- ✓ Raw materials inspected and stored properly
- ✓ Separate areas for raw and finished products
- ✓ Waste disposal systems in place
- ✓ Records maintained for cleaning, pest control, and staff training
- ✓ Staff trained in hygiene and food safety practices

Part III – Milk and Milk Product Units

(dairies, chilling centers, milk processing plants)

- ✓ Hygienic milking practices followed
- ✓ Containers cleaned and sanitized before use
- ✓ Milk chilled immediately after collection
- ✓ Pasteurization or sterilization as per standards
- ✓ Cold chain maintained during storage and transport
- ✓ Equipment cleaned daily with approved detergents/disinfectants
- ✓ Personnel wear clean clothing and maintain hygiene
- ✓ Veterinary checks for animals supplying milk
- ✓ Records of milk collection, processing, and distribution maintained

Part IV – Meat and Meat Product Units

(slaughterhouses, meat processing plants, cold storage)

- ✓ Slaughterhouses located away from residential areas
- ✓ Animals inspected by veterinarians before slaughter
- ✓ Hygienic slaughtering practices followed
- ✓ Floors and walls washable, non-absorbent, and easy to clean
- ✓ Adequate drainage and waste disposal systems
- ✓ Cold storage facilities maintained at prescribed temperatures
- ✓ Meat transported in clean, covered, refrigerated vehicles
- ✓ Staff wear protective clothing and maintain hygiene
- ✓ Records of animal health, slaughter, and distribution maintained

Part V – Catering/Food Service Establishments

(restaurants, hotels, canteens, caterers)

- ✓ Kitchen kept clean, well-ventilated, and pest-free
- ✓ Separate areas for raw and cooked food
- ✓ Food handlers wear gloves, aprons, head covers
- ✓ Handwashing facilities with soap and clean water available
- ✓ Cooked food stored at safe temperatures (hot >60°C, cold <5°C)
- ✓ Utensils and equipment cleaned after each use
- ✓ Waste disposed daily in covered bins
- ✓ No smoking, chewing, or spitting in food areas
- ✓ Records of cleaning schedules, pest control, and staff health checks maintained

Key Requirements

- ✓ **Premises:** Must be clean, well-ventilated, and pest-free.
- ✓ **Water Supply:** Safe and potable water for food preparation.
- ✓ **Equipment:** Regular cleaning and maintenance to avoid contamination.
- ✓ **Personal Hygiene:** Food handlers must maintain cleanliness, wear protective clothing, and undergo medical checks.
- ✓ **Storage & Transport:** Food must be stored at appropriate temperatures and transported hygienically.
- ✓ **Waste Disposal:** Proper systems for disposal of food waste and sewage.
- ✓ **Documentation:** FBOs must maintain records of cleaning schedules, pest control, and staff training.

Consumer Safety:

Prevents contamination and adulteration.

Legal Compliance: Mandatory for licensing under FSSAI.

Business Reputation: Builds consumer trust through hygiene ratings.

Risk Management: Reduces chances of foodborne illnesses.

Schedule IV of FSS Regulation 2011 is the hygiene rulebook for India's food businesses, ensuring that every stage of food handling meets safety standards.

The Path Forward…..

The road ahead is filled with potential. By integrating research findings and advanced technologies will dive us into broader understanding of food quality, one can revolutionize how one produce, process, and consume food. This is not only an opportunity to improve public health and safety but also to create more sustainable and nutritious food systems for the future.

THANK YOU
FOR PROTECTING
PUBLIC HEALTH EVERY DAY